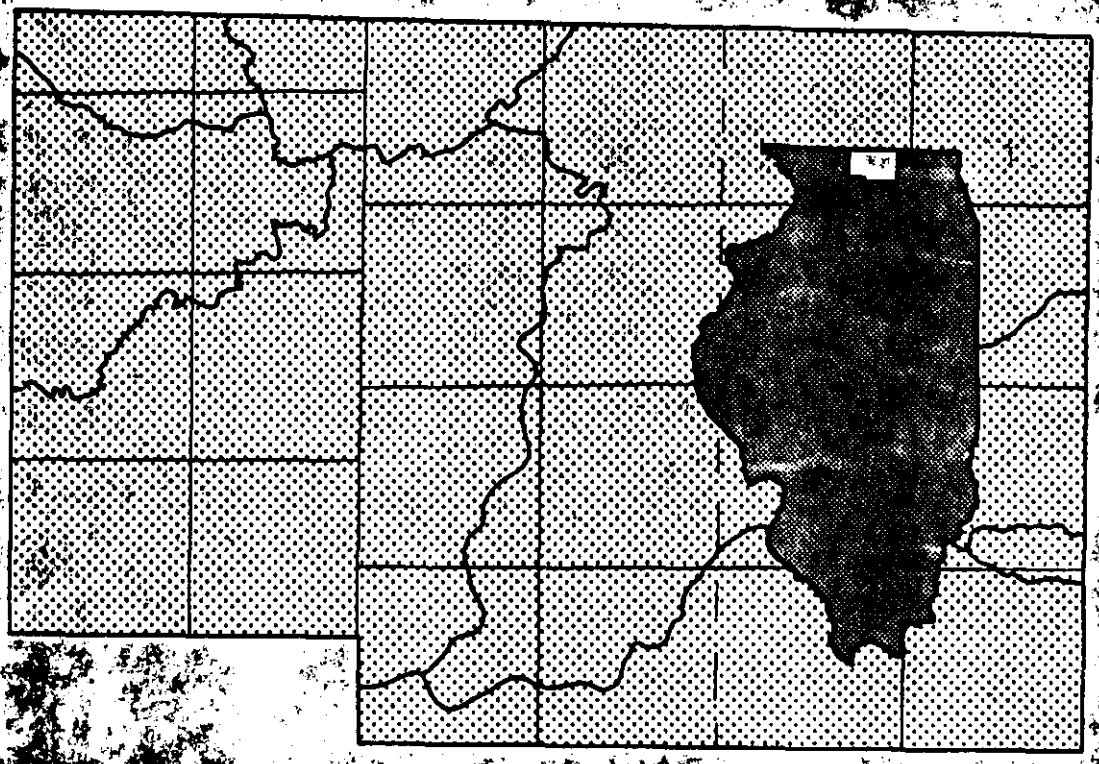
GEOLOGY FOR PLANNING IN BOONE AND WINNEBAGO COUNTIES, ILLINOIS

EXECUTIVE SUMMARY



Richard C. Berg, John P. Kempton, and Amy N. Stecyk

Illinois State Geological Survey
Champaign, Illinois

With Contributions from Numerous Members of the Staff of the Illinois State Geological Survey
and
Dennis P. McKenna
Winnebago County Soil and Water Conservation District

December 1981

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PREFACE

This is a summary of the work and products prepared under contract to the Boone and Winnebago County Boards through the University of Illinois, and funded proportionally by each County.

This project is described as "A Geologic Study of Boone and Winnebago Counties, Illinois, with Special Attention to Groundwater Conditions, Mineral Resources Availability and Land-Use Suitability" in the "Agreement for Cooperative Investigation" as agreed by the County Boards and the Illinois State Geological Survey. Detailed descriptions of data and full interpretations presented in the Technical Report submitted to the Counties are summarized in this brief Executive Summary. Also attached to this Summary are reduced copies of the principal maps (plates) which accompany the Technical Report. The complete technical report and maps are available at the County Board Offices as well as other county and municipal offices.

INTRODUCTION

It is generally recognized that Boone and Winnebago Counties have abundant water resources. Groundwater is available throughout both counties and is obtained for domestic, industrial, and municipal uses from depths as shallow as 20 to 40 feet to over 2000 feet. This is in contrast to many areas of Illinois where finding even a small household groundwater supply is difficult at best.

However, the same geologic conditions that dictate the availability of groundwater also control the sensitivity of an area to potential groundwater (and surface water) contamination from improper or intensive waste disposal practices and overapplication of agricultural chemicals. Therefore, in areas where groundwater availability is a serious problem, the geologic conditions are frequently suitable for at least some types of waste disposal with little or no fear of groundwater contamination. In Boone and Winnebago Counties, potential contamination of groundwater is a serious problem because of the presence of shallow, water-yielding materials which may allow rapid infiltration of contaminants to enter these sources of water.

It was primarily because of existing or potential groundwater contamination problems that this study was initiated. The location of suitable landfill sites, the potential for contamination from existing disposal sites, and the development of large suburban communities with large concentrations of individual waste disposal (septic) systems have become problems of serious concern.

PURPOSE OF STUDY

Certain potential environmental problems are often associated with rapidly expanding urbanization and changes in land use. This also extends to agricultural land that comprises 89 percent of Boone County and 68 percent of Winnebago County, where certain land-use practices may also have detrimental effects on earth resources. The purpose of this study, therefore, is to provide geologic information necessary for both public and private planning and development activities in Boone and Winnebago Counties.

Detailed data on the distribution and character of geologic materials over or through which water moves is essential to an understanding of the effects of man's activities on water availability, quantity and quality. Although this report emphasizes information related to the protection of water resources, other interpretations for construction conditions and mineral resources provide the remaining elements for comprehensive resource-based land-use planning and an aid for local development. A brief discussion of some of the physical data and mapping necessary for such resource-based planning is presented in this summary, particularly the basic mapping procedures and characterization of the geologic materials.

METHODS

The uppermost 5 feet of materials were determined by compiling 82 soil series on USDA Soil Conservation Service soil survey maps into 19 soil/parent material groups. The soil/parent material groups were defined according to types of geologic materials and differentiated on the basis of their composition, and position on the landscape. Basic parent materials are loess (windblown silt), paleosols (ancient soil) developed in tills (a mixture of sand, silt, clay, pebbles and boulders deposited by glacial ice) colluvium (slope wash), alluvium (stream deposit), bedrock residuum (weathered dolomite or shale), and sand and gravel. Supplemental surficial data as well as subsurface data were provided by evaluating over 1800 samples of geologic materials from 308 surface exposures and drilling locations. All samples were subjected to textural and/or clay mineral laboratory analyses. Over 700 samples were analyzed specifically for this project. The remainder were analyzed in previous investigations in the counties; however, many of these were restudied to insure consistency of the data.

An integral part of the project was a test drilling program to provide an expanded level of knowledge on the subsurface glacial geology of Boone and Winnebago Counties. The test drilling was considered important for the following reasons:

1. Provide representative samples of geologic materials at key locations and at depths greater than provided by other drilling or surface exposures to establish a framework for tracing the continuity of glacial tills and sand and gravel aquifers. Numerous cross sections were constructed across the counties to comprehend these relationships (fig. 1). Figures 2 and 3 are cross sections down the center of the two major bedrock valleys, the Rock and Troy Valleys. Four additional cross sections are presented in the Technical Report.

2. Provide the control to develop a geologic framework for existing water-well logs and samples, thereby improving the value of existing well data for delineating drift aquifers.

3. Fill in significant gaps in the distribution of subsurface data.

4. Provide additional information on the thickness of glacial deposits and the areal geology (fig. 4) and elevation of the bedrock surface, particularly in the deep bedrock valleys.

A total of 29 test holes was drilled in the two counties--13 contract test holes funded by the two counties (six in Boone and seven in Winnebago) and 16 test holes drilled by the Illinois State Geological Survey.

A total of 3549.5 feet was drilled--1527.5 feet in Boone County, and 2022 feet in Winnebago County; and 417 core (split spoon) samples were taken (216 in Boone and 201 in Winnebago). An additional 317 samples of rotary cuttings (130 in Boone and 187 in Winnebago) were also collected. The locations of these test holes are shown on figure 1.

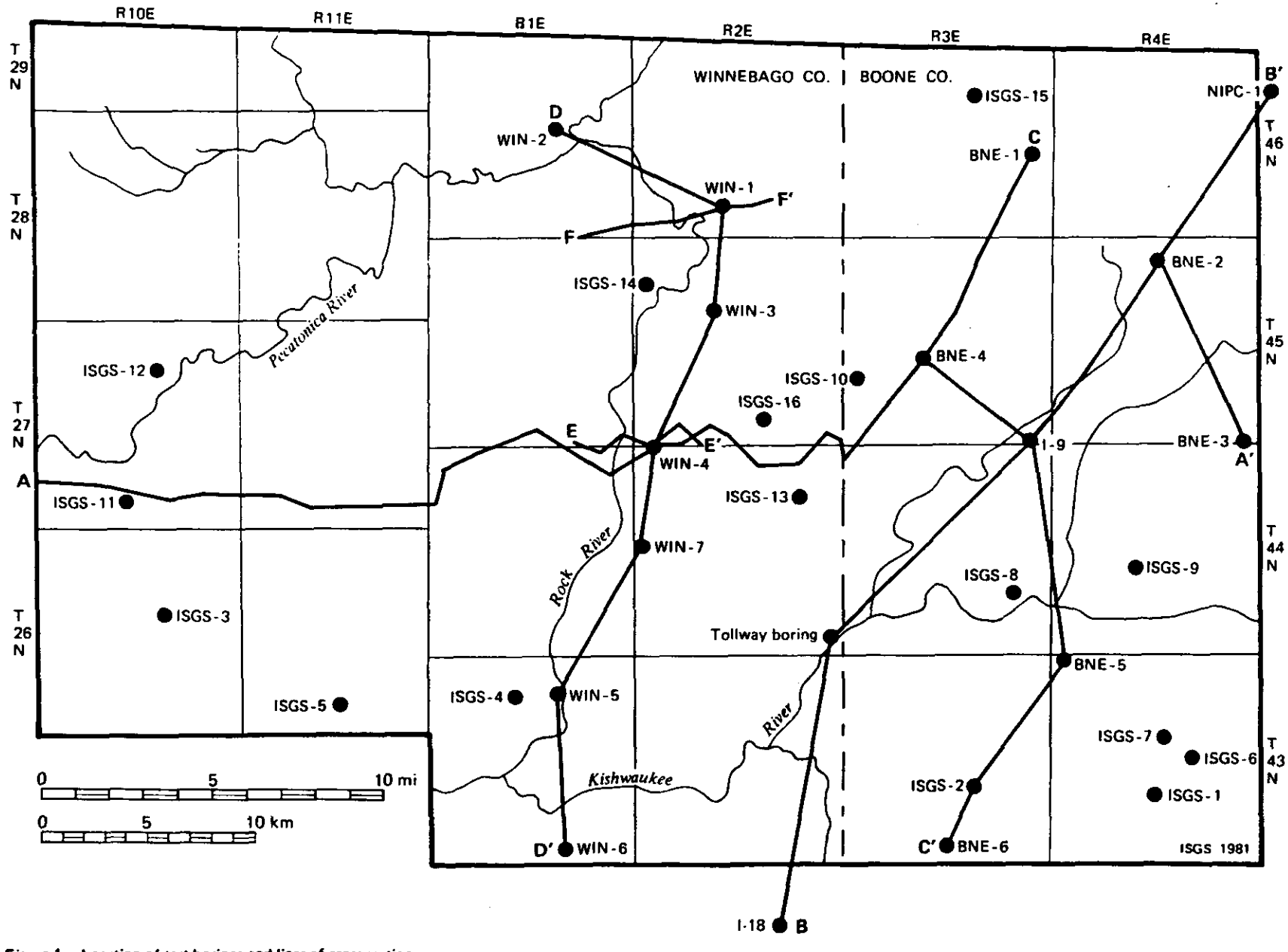


Figure 1. Location of test borings and lines of cross section.

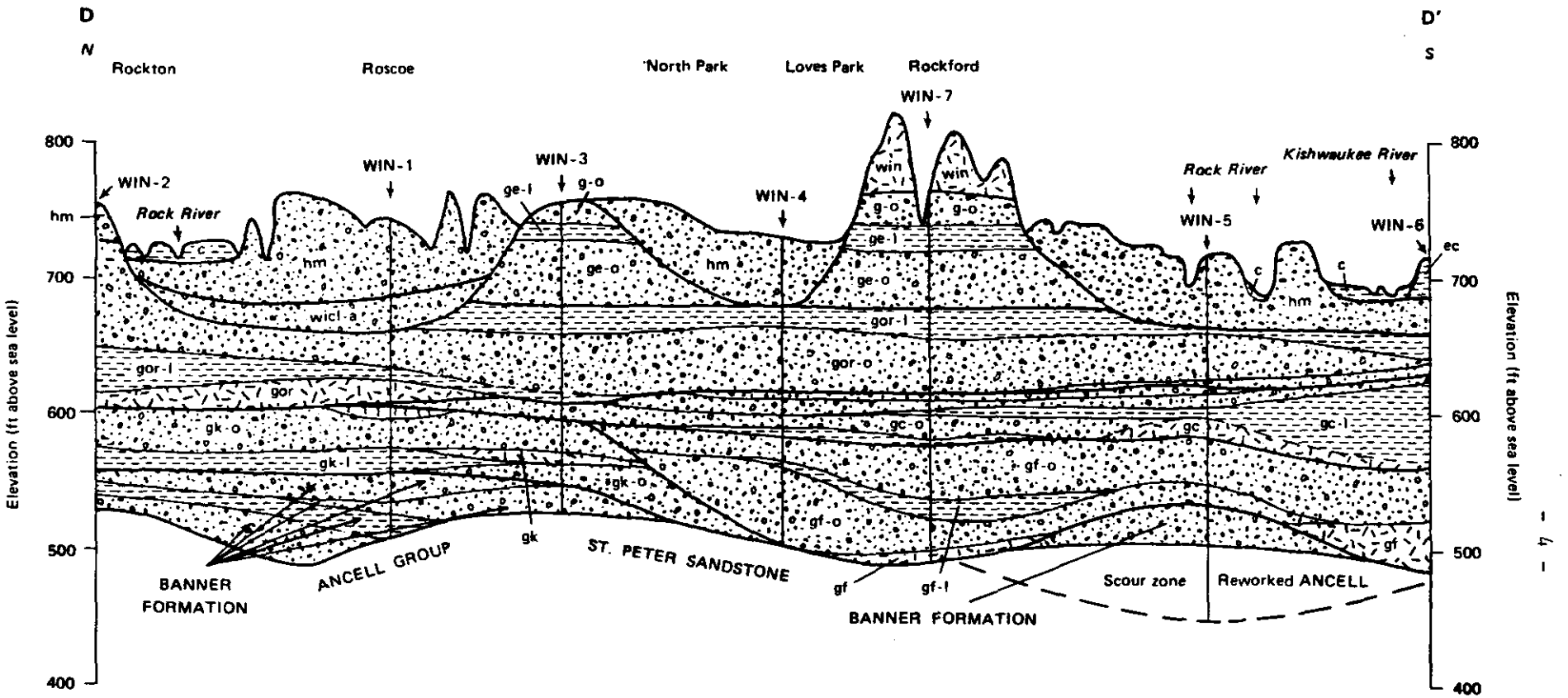
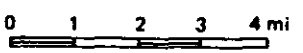


Figure 2. N-S cross section along Rock River Valley.



Till and other deposits related to:

Stack symbol	Till member
wic	Capron
wicl	Clinton
wia	Argyle
win	Nimtz
gb	Belvidere
ge	Esmond
gor	Oregon
gc	Creston
gf	Fairdale
gh	Herbert
go	Ogle
gk	Kellerville
g-o	Uppermost Glasford Formation outwash
-l	Lacustrine
-o	Outwash

Lacustrine sands, silt and clay

Outwash sand and gravel

Till

Organic materials (or) buried soil

Specific borings indicated

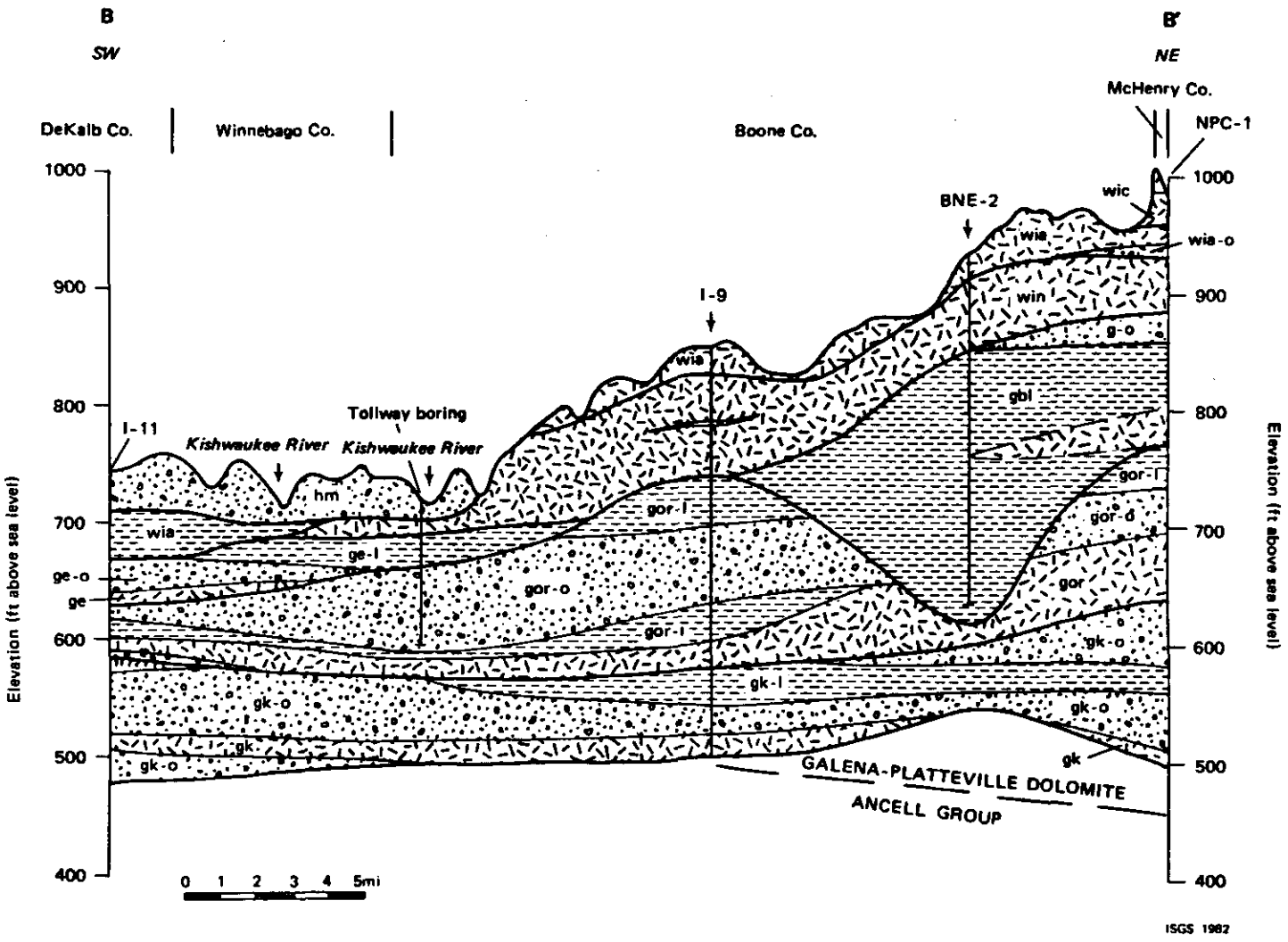


Figure 3. SW-NE cross section along lowest part of Troy Bedrock Valley from northern De Kalb County to northwest McHenry County. (see figure 2 for legend)

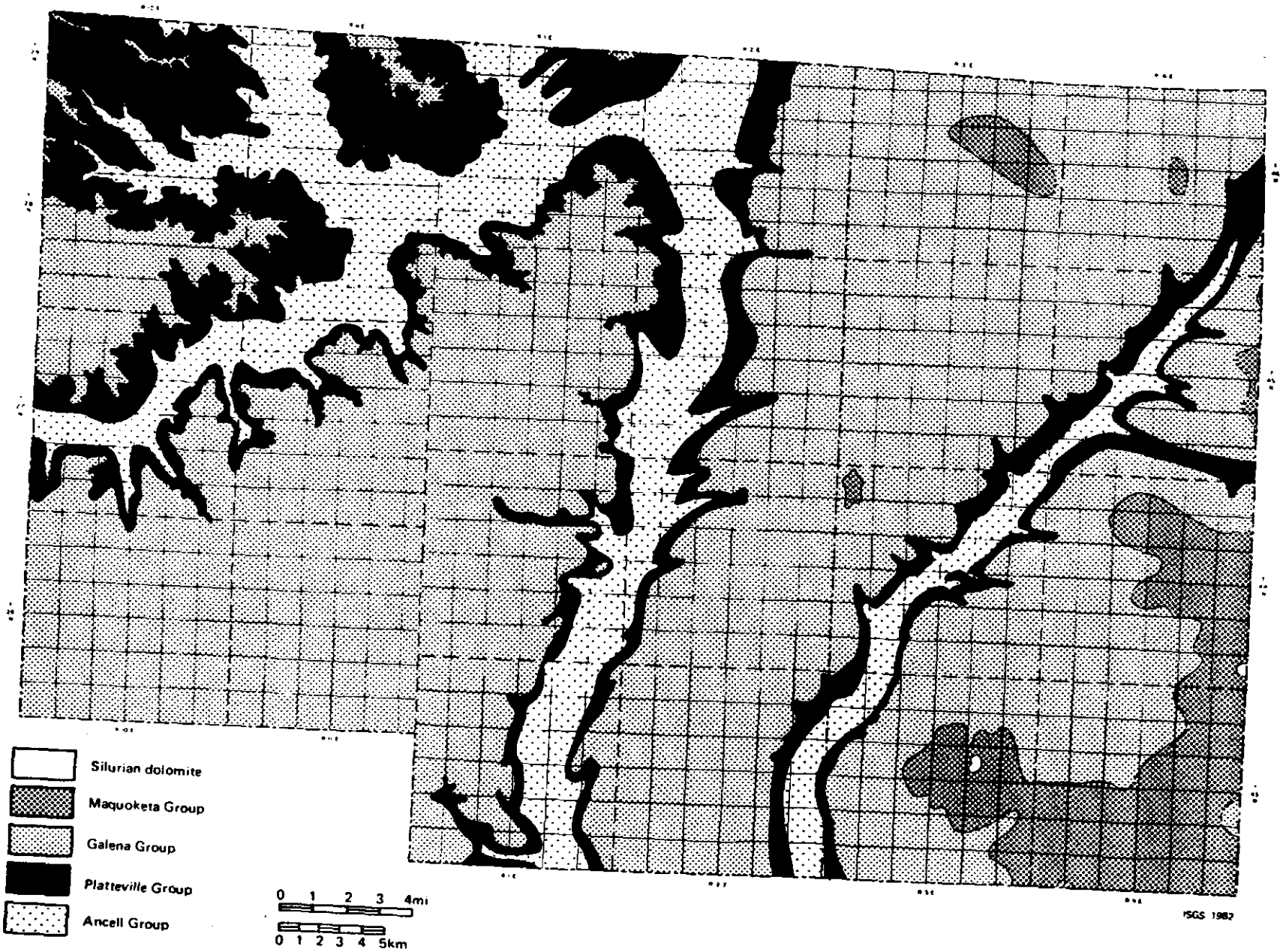


Figure 4. Areal geology of the bedrock surface.

SUMMARY OF OBSERVATIONS AND FINDINGS

By combining the surficial geologic information with the subsurface geologic data, the areal and stratigraphic distribution of materials was outlined. The main product of this study has been the establishment of a predictable and mappable sequence of surficial materials. This is shown on plates 1 through 4 and figures 2, 3 and 4. An investigation of the composition, thickness and regional extent of both glacial drift and bedrock materials provides the basic geologic data necessary for the construction of interpretive maps. The basic maps include those on geologic materials mapped to a depth of 20 feet (plate 1), bedrock topography (plate 2), drift thickness (plate 3), and soils subject to flooding and seasonally high water tables (plate 4). Basic data are also shown on diagrams similar to figures 2 and 3 where all geologic materials between land surface and the bedrock surface are shown by cross sections and on figure 4 showing the surficial bedrock geology. Based on these maps and data, secondary maps showing principal terranes and glacial drift aquifers were constructed as well as interpretive maps on waste disposal, construction and mineral resources.

The following is a list of the more important observations and findings of this study concerning the geology, land-use capabilities and resources of Boone and Winnebago Counties. These findings are not necessarily listed in order of importance.

Geologic materials

Geologic materials are classified into two major types--bedrock and glacial drift. Bedrock materials present at the surface of the bedrock directly below the glacial drift consist of dolomite, shale and sandstone. The St. Peter Sandstone (Ancell Group) is at the bedrock surface only at the bottom of the Rock, Sugar, Pecatonica and most of the Troy Bedrock Valleys and exposed at land surface on the uplands in norhtwestern Winnebago County. It is a primary aquifer for both municipal and private water supplies. The Galena and Platteville Dolomite Groups are the surficial bedrock units over most of the area and are extensively quarried and also a source of groundwater for domestic use. The Maquoketa Shale Group is present only in southeastern Boone County. Two local erosional remnants of Silurian dolomite are also present in southeastern Boone County.

Glacial drift is composed primarily of till (ice-laid deposits) and outwash or lacustrine deposits (coarse and fine-textured water-laid deposits). Windblown sand and silt, colluvium (slope wash deposits), alluvium (stream deposits), and to a lesser extent, peat, often overlie the till, outwash or lacustrine deposits. The Capron, Clinton, Argyle, Nimtz, Oregon, Fairdale and Ogle Tills comprise about 85 percent of the upland area in the two-county region. Sandy tills by far are the dominant surficial drift materials. Loam or fine-textured tills, the Esmond, Belvidere and Creston, occur in southern Boone County and extreme southeastern Winnebago County.

Extensive deposits of sand and gravel outwash are found in the Rock, Sugar and Kishwaukee River Valleys and their major tributaries, the South Branch Kishwaukee River, Coon Creek and Piscasaw Creek. Sand and gravel also occurs in linear ridges (eskers) and hills (kames) primarily in southern Boone County. Along portions

of Beaver Creek in Boone County and the eastern valley wall of the Rock River in Winnebago County, sand and gravel outcrops beneath till, and in places forms a rather extensive unit. Finally, lacustrine (water-laid) silts and clays are present primarily in the Pecatonica River Valley and in small tributary valleys to the Rock and Kishwaukee Rivers and Piscasaw Creek.

Bedrock topography and drift thickness

The most obvious features of the bedrock topography (plate 2) and drift thickness (plate 3) maps are extensive and deep bedrock valleys containing thick glacial drift. Figure 5 is a cross section across northern Boone and Winnebago Counties, perpendicular to the axes of the Pecatonica, Rock and Troy Valleys. The diagram shows the general distribution of drift over the area and compares the degree on infilling and depth and configuration of the three bedrock valleys. The Pecatonica-Sugar-Rock Valley in Winnebago County has up to 300 feet of drift and the Troy Valley in Boone County has over 450 feet of drift. The uplands between the bedrock valleys can be grouped into four main areas: west of the Rock Valley and south of the Pecatonica Valley drift is generally less than 20 feet thick; however, numerous small tributaries throughout the region are filled with drift over 50 feet thick; west of the Rock Valley and north of the Pecatonica Valley drift is commonly less than 5 feet thick; east of the Rock Valley and northwest of the Troy Valley, mostly in northern Boone County, drift is mostly over 50 feet and commonly over 100 feet thick; east of the Rock Valley and south and east of the Troy Valley, drift is usually between 50 and 100 feet thick; however, areas of less than 50 feet of drift are common. In general, when the drift is less than 50 feet thick, the bedrock topography exerts a direct control on the local relief of the modern topography.

Soil drainage

Soils with drainage problems occur extensviely throughout Boone County. Restricted areas of well-drained soils occur in the sand and gravel deposits of the Kishwaukee River and Piscasaw Creek, on kames and eskers in southern Boone County, and on knolls and sloping terrains in northern Boone County.

Winnebago County, by contrast, contains large areas of mostly well drained soils. Soils with drainage problems occur, however, scattered throughout the uplands, along major rivers and in small upland drainageways.

Terranes

The landscape is divisible into two major terrains--uplands and lowlands. Based upon the distribution of geologic materials upon these terrains is derived a classification consisting of both landscape elements and materials called terranes (plate 5). Broad and relatively flat upland areas underlain by dolomite are present in central Winnebago County. Those underlain principally by till are present throughout eastern Winnebago and most of northern and portions of southern Boone County. Sloping areas underlain by dolomite dominate much of western Winnebago County.

In eastern Winnebago County and central Boone County land areas slope toward the Rock and Kishwaukee Rivers and Piscasaw Creek. Further subdivisions of the uplands separate the sandy till areas from the loamy to silty-clay till areas. Lowlands are broadly categorized into those underlain principally by sand and gravel and those underlain by lacustrine silt and clay. The former occurs in the Rock,

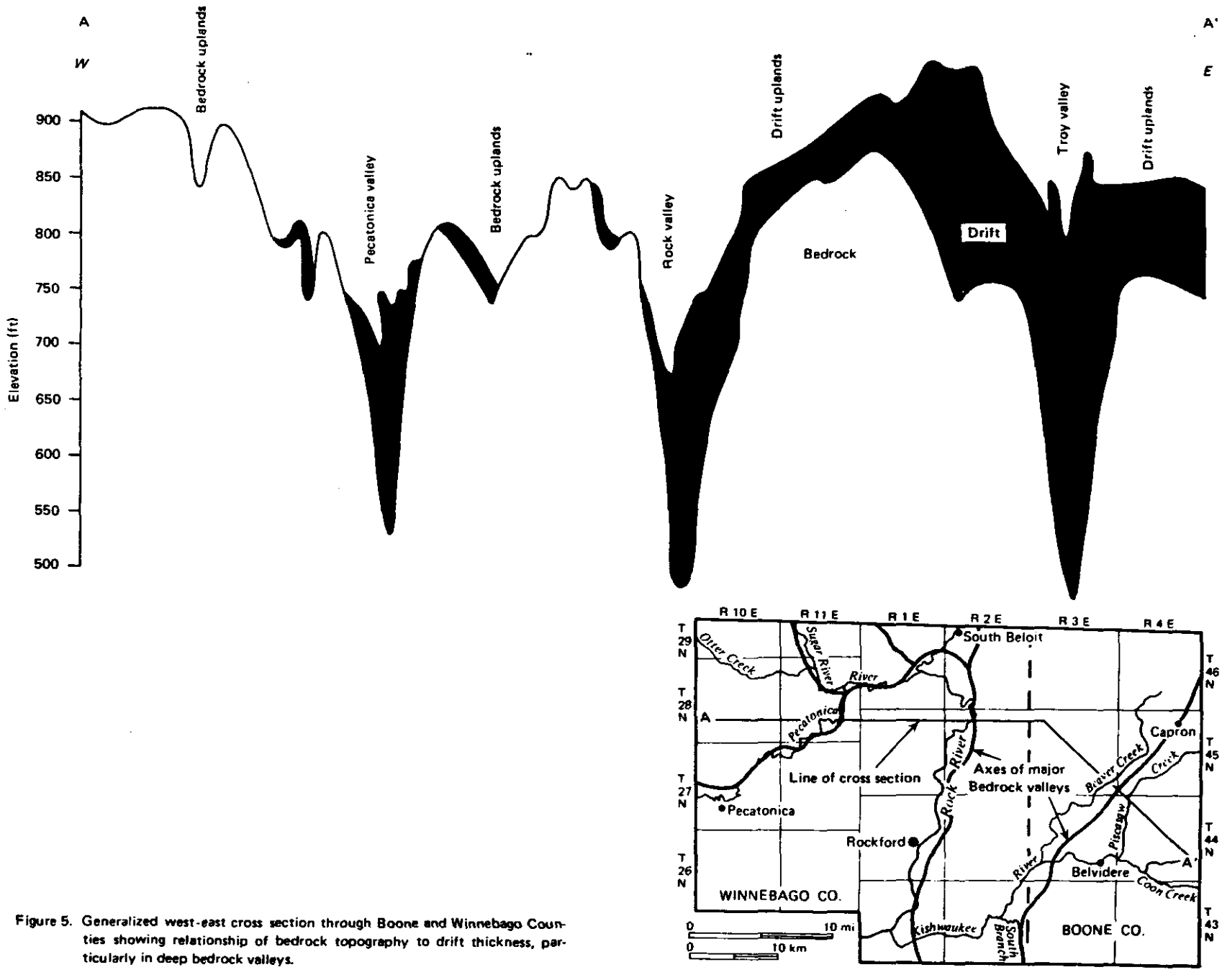


Figure 5. Generalized west-east cross section through Boone and Winnebago Counties showing relationship of bedrock topography to drift thickness, particularly in deep bedrock valleys.

Sugar and Kishwaukee River Valleys and Piscasaw Creek Valley, while the latter occurs mostly in the Pecatonica River Valley.

Bedrock aquifers

Boone and Winnebago Counties have abundant water resources, both from deep and shallow sandstone aquifers and relatively shallow dolomite aquifers within the bedrock. Most of these bedrock aquifers are present throughout both counties.

Sand and gravel aquifers

Sand and gravel aquifers yielding moderate to large groundwater supplies are present in the glacial drift at relatively shallow depths in the extensive sand and gravel deposits of the Rock, Kishwaukee and Piscasaw Valleys. Sand and gravel aquifers are also present within the thick glacial drift below the uplands of northeastern Boone County. Drift aquifers are generally thin and discontinuous in the thicker drift areas of southern Boone County and southeastern Winnebago County. They are only locally present in the fill of the Pecatonica Valley west of the Sugar River.

Land burial of wastes

Areas with geologic conditions having the least potential for groundwater contamination from land burial of wastes (landfills) are present in upland areas of southern Boone County and southeastern Winnebago County, where relatively flat areas contain loamy to silty clay till, greater than 50 feet thick. Maquoketa Shale underlying the drift units, as it does over much of southeastern Boone County, adds an additional safeguard. The areas least favorable for landfills are those with dolomite bedrock or sand and gravel within 20 feet of the surface. This includes almost all of western Winnebago County as well as the Rock and Kishwaukee River Valleys and their tributary valleys. Some of the thicker, sandy till areas in eastern Winnebago County and northern Boone County, as well as thicker drift areas in restricted portions of western Winnebago County, may contain favorable landfill sites; however, subsurface geologic data are lacking in many of these areas. These intermediate areas, in particular, require extensive on-site investigations. Even for location of a landfill in the more favorable areas, the map is to be used only as a guide and does not replace the need for confirmatory on-site investigation and evaluation of geologic materials.

Septic tanks

The classification of geologic materials for septic tank soil absorption fields indicates that areas often having the least acceptance problems (where they work best) have the greatest potential for or are most sensitive to contamination of the groundwater. These areas include much of northwestern Winnebago County and within the major river valleys where bedrock or sand and gravel, respectively, are within 5 feet of the surface. Conversely, the areas with the greatest acceptance problems, namely the finer-grained till and lacustrine areas of southern Boone County and the Pecatonica Valley of Winnebago County, have the least potential for or are least sensitive to contamination. The areas where septic systems may work best and have minimal potential for groundwater contamination are found over the thicker drift areas of northern Boone County and portions of western Winnebago County.

Although geologic materials appear relatively favorable for septics in these areas, much of the thicker drift areas of western Winnebago County is steeply sloping, while most of northern Boone County has severe soil drainage problems including high water tables and/or perched water. Sloping areas may result in effluent coming to the surface immediately downslope along subsurface material contacts, while soils with drainage problems may result in the effluent not infiltrating and often coming to the surface during wet seasons. Another problem that was considered is the density of septic units occupying a particular geologic setting. Even areas most sensitive to contamination can accommodate septic systems when spaced far enough apart and not all in the same groundwater flow path. When evaluating areas favorable for septic tank systems, geologic materials, soil drainage conditions as well as the density of septic tank units must all be considered.

Surface application of wastes

The classification of geologic materials for surface application of wastes and agricultural chemicals is similar to that on septic tanks; therefore, both were placed on the same map. The one major difference is that wastes or chemicals applied to the surface can take full advantage of the mitigating role of the entire soil profile to attenuate contaminants. A septic tank, placed 3 to 5 feet below the surface, takes only partial advantage, if any, of this mitigating role. One of the most important factors to consider in the surface spreading of wastes is sloping topography that encourages both the runoff of wastes into streams or, assuming that some contaminants have permeated the soil, exiting of wastes along material boundaries. Areas least favorable for surface application of wastes due to geologic materials or sloping topography occur over much of western Winnebago County, along the slopes of the Rock and Kishwaukee River and Piscasaw Creek Valley walls, and in areas of thin soil on the sand and gravel areas of the major river valleys. Areas most favorable are those with no acceptance problems on relatively flat areas on uplands. Except for steeply sloping areas where excessive runoff can cause surface water contamination, the controlled use of agricultural chemicals or surface spreading of sewage sludge should not cause significant contamination of surface or groundwater supplies. However, in the area mapped as most sensitive to contamination, proper application rates and the number of applications should be carefully evaluated. Groundwater monitoring may be necessary to insure that groundwater quality remains at an acceptable level. Waste products or chemicals injected below the surface may have less attenuation and should therefore be monitored even more rigidly in the most sensitive areas.

General construction

The map showing geologic conditions for general construction shows regions of similar conditions for various types of foundations and excavations; it also indicates the type of geologic materials and conditions that may cause problems. The principal considerations in preparing the map of general construction conditions were flood susceptibility, depth to bedrock, drainage characteristics, bearing capacities, ease of excavation and natural hazards. Natural hazards include presence of peat and muck, poorly-drained fine-textured lacustrine deposits, shallow artesian conditions, slope instability, frost susceptibility and shrink/swell characteristics. The advantage or limitation of each geologic area is shown within the framework of each condition described.

By combining the map of construction conditions with other appropriate maps, the conditions relative to most types of development or construction can be determined, provided that site evaluations verify the conditions.

Mineral resources

Two mineral resources, sand and gravel and dolomite, are locally abundant in Boone and Winnebago Counties. Sand and gravel for use as road material and concrete aggregate is available from the extensive outwash deposits in the valleys of the Rock and Kishwaukee Rivers and Piscasaw Creek. Some sand and gravel is also exposed along the valley walls on the east side of the Rock River Valley in Winnebago County, the north side of Beaver Creek in western Boone County, and a small area on the north side of the Kishwaukee River in eastern Boone County. Other small areas of sand and gravel are present locally in scattered areas of both counties.

While many pits are currently producing sand and gravel from the principal Rock and Kishwaukee Valley deposits, conflicts over land use may continue to restrict its availability. Therefore, efforts to assure future availability should be given consideration.

Dolomite, while of great abundance, is restricted by overburden limitations and by the quality necessary for local use.

Finally, the following observations may be helpful in focusing on future land-use and resource development considerations in each county.

(1) Planning and zoning should be directed at encouraging the location of future sites for land burial of wastes in the least sensitive geologic environments. These are the upland areas underlain by relatively thick, fing-grained deposits. Since earth materials have a finite capacity for attenuation of contaminants, large landfills may pose more of a threat to the groundwater reservoir than a number of dispersed small landfills.

(2) Areas considered to have a high potential for contamination of aquifers should be monitored in developed or developing areas to assure there is no deterioration of groundwater quality.

(3) A policy of multiple sequential use of areas of mineral extraction should be considered, particularly for gravel pits.

(4) Inasmuch as new data on geology, mineral resources, water resources and environmental problems will continually be developed from the intense human activity in Boone and Winnebago Counties, programs should be established for the collecting and managing of the data and updating the basic maps and modifying the criteria and details of the interpretive maps as needed.